1.13

FORECAST METHODOLOGY USING THE GFE SUITE

Tracy Hansen, M. Mathewson, T. J. LeFebvre, and M. Romberg
NOAA Forecast Systems Laboratory, Boulder, CO*

1. INTRODUCTION

The Graphical Forecast Editor (GFE) is the grid editing component to the Interactive Forecast Preparation System (IFPS) which introduces a new approach to weather forecasting. How will this grid-based paradigm work in the field and be integrated into current practices? In this paper, we examine forecast methodology using the GFE Suite software. We first recognize that there is no ONE forecast process.

The steps to build a gridded forecast will vary with each site, forecaster, and situation. Thus, our goal has been to study specific representative scenarios and, from them, glean a general end-to-end process to act as a guideline.

There are three primary phases when using GFESuite software: In the Set Up Phase, the forecaster uses weather models to initialize the surface weather element grids. In the Edit Phase, the forecaster injects his knowledge and expertise by editing the grids and checking for consistency. In the Product Generation Phase, the forecaster creates products such as GIF images, text products in phrase or tabular form, or intermediate data to be processed by other components of the IFPS system. At each phase, "smart" tools are available for the forecaster to customize the software.

2. A NEW PARADIGM IN FORECASTING

The Interactive Forecast Preparation System (IFPS) is a revolutionary new method of producing forecasts. In the past, the techniques used by the National Weather Service (NWS) to generate products began with the meteorologists sitting down at workstations, examining all available guidance (e.g., model data, observations, satellite and radar data), and forming service-specific mental pictures of the forecast. The office duties were usually split across services so there was a public, a marine, and an aviation forecaster. After each meteorologist determined the forecast, he/she would discuss it with the others to ensure that the forecasts were consistent. Then they would return to their workstations and type out all of the various forecast products. In most cases, all forecast products were in text format. (See Figure 1).

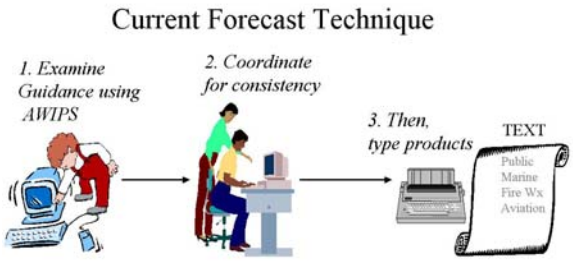

Figure 1. Current NWS Forecast Technique

Interactive Forecast Preparation has revolutionized the method of generating forecasts by introducing the concept of a digital forecast. Making a digital forecast, rather than a text forecast, represents a major paradigm shift for the forecaster, but offers great benefits. The method of producing these digital forecasts begins as before, with the forecaster examining all available guidance, but here, the similarity stops. The mental picture is no longer service-specific, but, instead, is a general view of the atmosphere in terms of sensible weather elements.

As the mental picture of the forecast is gelling, the meteorologist enters this "picture" into the computer in a digital form, which we call "grids." Grids can represent a variety of weather elements at practically any spatial and temporal resolution. Grids are two-dimensional maps of a forecast area where a single grid point represents a particular weather element at one location at a specific time.

Machines can now coordinate the forecasts between the various forecasters. Since the forecast is in digital form, the generation of forecast products can be more automated. Digital forecasts provide output in not only textual form, but as graphics, imagery, and grids as well. (See Figure 2)

**Corresponding author address*: Tracy Hansen, NOAA Forecast Systems Laboratory, 325 Broadway R/FS6, Boulder CO 80305; e-mail: hansen@fsl.noaa.gov

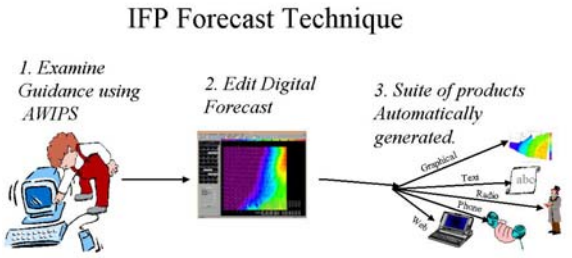

Figure 2. IFP Forecast Technique

IFPS has some very important characteristics that distinguish it from conventional forecast preparation techniques:

- The official forecasts are represented in digital form, and not text.
- All forecast products are generated from the digital forecast.
- Graphical editors are used to define the digital forecast.
- Numerical techniques are used to derive first-guess forecast fields directly from the models.

There are many benefits to IFPS. All forecast products are consistent since they are all generated from the same digital data source. Product generation is no longer time consuming and new services, i.e., products, can be produced with little effort. Perhaps most important is that the forecaster can finally disseminate the detail in forecasts that is known and understood and could not be expressed due to the inability of text products to accommodate the detail.

Creating and editing grids is a very different activity from writing descriptive text products for specific zones and time periods. This will require new techniques and operational procedures. It is important to study how this new approach will work in the field. How can the transition from current operations to grid-based forecasting be facilitated? How can we design the software to be most useful and intuitive? Understanding forecast methodology helps us answer these questions.

3. FORECAST PROCESS IN THE NEW PARADIGM

Given the wide variety of weather conditions across the US, there can be no ONE forecast process. We find everything from blizzards in the mountains to thunderstorms on the plains to tropical storms along the coasts. In addition, each forecaster may have his or her favored approach to each situation. Weather forecasting is a complex and sophisticated endeavor that makes it very challenging to capture and understand.

Our strategy to understanding forecast methodology has been to choose representative scenarios. We examine a particular terrain under certain meteorological conditions and understand how an individual forecaster would express the situation using the GFE software. One such scenario is shown in Figures 3a and b. Figure 3a shows a Convective Scenario: warm and cold fronts around a low-pressure system with areas marked according to the type of precipitation they are likely to receive. Figure 3b shows how the forecaster will use the GFE software to "paint" Probability of Precipitation grids and then automatically generate Weather grids using "Smart Tools."

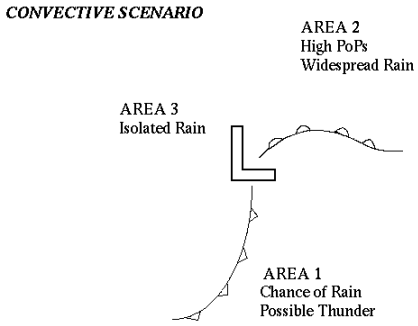

Figure 3a. Convective Scenario

From studying these types of representative scenarios, we were able to map out a more general process. We put the scenarios into a larger context asking what needed to happen before and after the steps given. The high-level forecast process that emerged is shown in Figure 4.

There are three major phases: In the Set Up Phase, the forecaster uses weather models to initialize the surface weather element grids. The forecaster will study the current models (e.g., Eta, RUC, MRF), and favor one or the other for short and long term predictions. The forecast grids are then initialized with the selected models.

In the Edit Phase, the forecaster injects his knowledge and expertise by editing the grids and checking for consistency. Simple "paint" and drawing tools allow the forecaster to express simple, local effects while "smart tools" can manipulate large amounts of data according to meteorological equations (LeFebvre 2000). When all the grids are generated, they can be

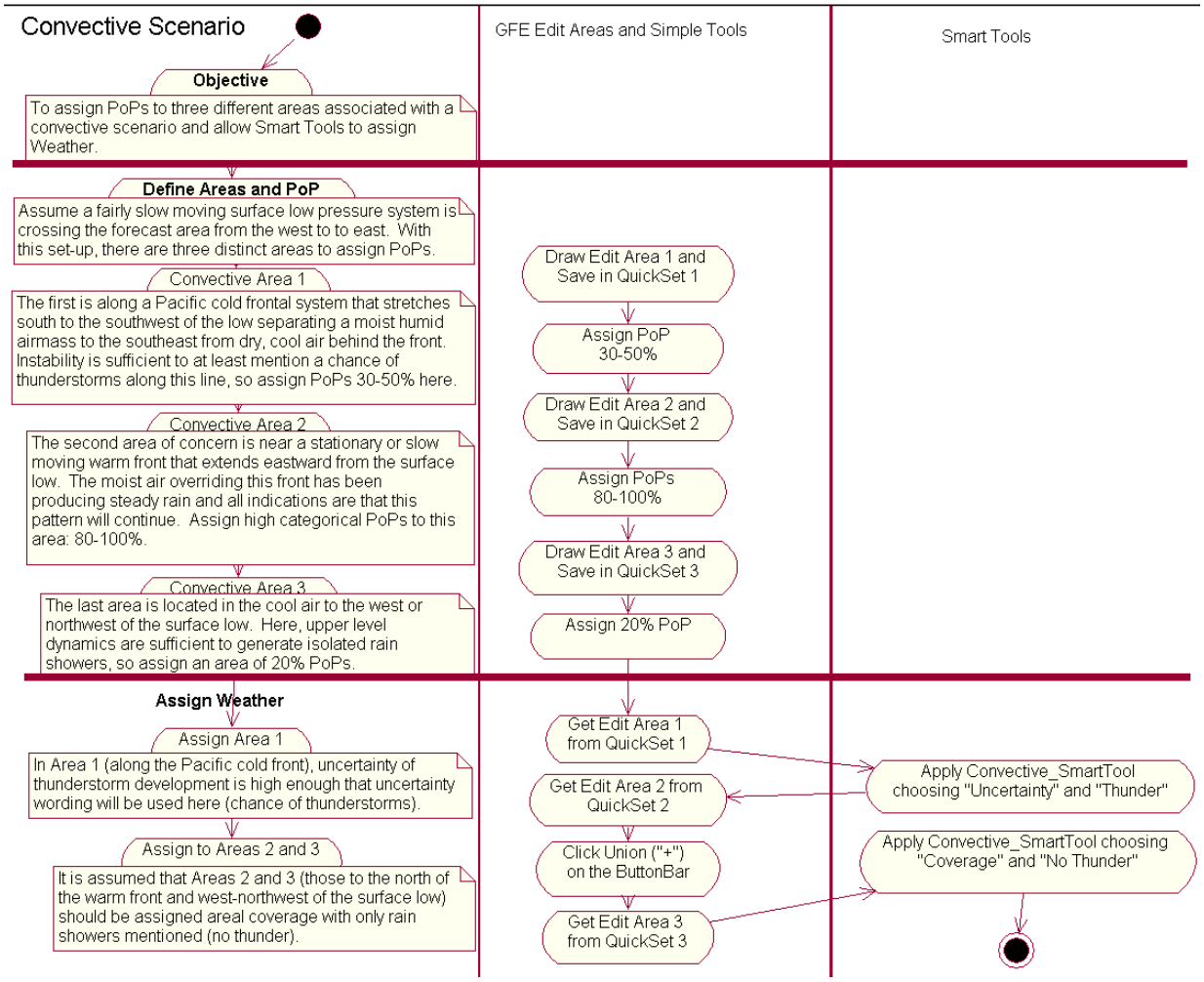

Figure 3b. Convective Scenario

crosschecked for consistency, again, using "smart tools."

In the Product Generation Phase, the forecaster creates products such as GIF images, text products in phrase or tabular form, or intermediate data to be processed by other components of the IFPS system. GIF images can be automatically generated and may include data images, contours, wind barbs, map backgrounds, and topography. Text products can be created and tailored by the local offices using "smart" text product generators. The grids can be converted to an ASCII or GRIB format for input to other systems.

4. BENEFITS AND FUTURE WORK

The purpose of exploring Forecast Methodology is NOT to dictate how the forecaster's job should be done. Rather, the scenarios serve as a launching point for understanding and transitioning to the new grid-based paradigm. In addition, they provide a common language between forecasters and the software developers and guide software requirements so that tools can be built to support the complex task of forecasting.

The scenarios are excellent training tools that illustrate not only the individual features of the software system, but also how to produce useful forecast products in the context of real-world situations. They give the novice the "big picture" and provide incentive for using the tools.

We have built a Methodology Page at the RPP web site (http://www-md.fsl.noaa.gov/eft/rpp) as a repository for these ideas and plan to continue ongoing discussions between Forecasters and

Developers so the methodology of grid-based forecasting and the transition from current practices can emerge.

5. REFERENCES

LeFebvre, T. J., Mark Mathewson, Mike Romberg and Tracy Hansen, 2000: Injecting Meteorology into the GFE Suite. Preprints, *Seventeenth Conference on Weather Analysis and Forecasting*, Albuquerque NM, Amer. Meteor. Soc.

LeFebvre, T. J., Corby A. Bacco, and Mike Romberg, 1996: Gridded Forecast Products and Services Under Development at FSL. Preprints, *Fifteenth Conference on Weather Analysis and Forecasting*, Norfolk VA, Amer. Meteor. Soc.

LeFebvre, T. J., 1995: Operational Forecasting With AFPS. Preprints, *Eleventh International Conference on Interactive Information and Processing Systems for Meteorology, Oceanography, and Hydrology*, Dallas TX, Amer. Meteor. Soc.

Mathewson, M. A., 1996: Using the AWIPS Forecast Preparation System (AFPS). Preprints, *Twelfth International Conference on Interactive Information and Processing Systems for Meteorology, Oceanography, and Hydrology*, Atlanta GA, Amer. Meteor. Soc.

Wier, S. K., and J. S. Wakefield, 1996: Using numerical model output to provide initial forecasts of surface weather for the AFPS. Preprints, *Twelfth International Conference on Interactive Information and Processing Systems for Meteorology, Oceanography, and Hydrology*, Atlanta GA, Amer. Meteor. Soc.

Wier, S. K., 1995: Interpolating Between Grids of Meteorological Data for AFPS. Preprints, *Eleventh International Conference on Interactive Information and Processing Systems for Meteorology, Oceanography, and Hydrology*, Dallas TX, Amer. Meteor. Soc.

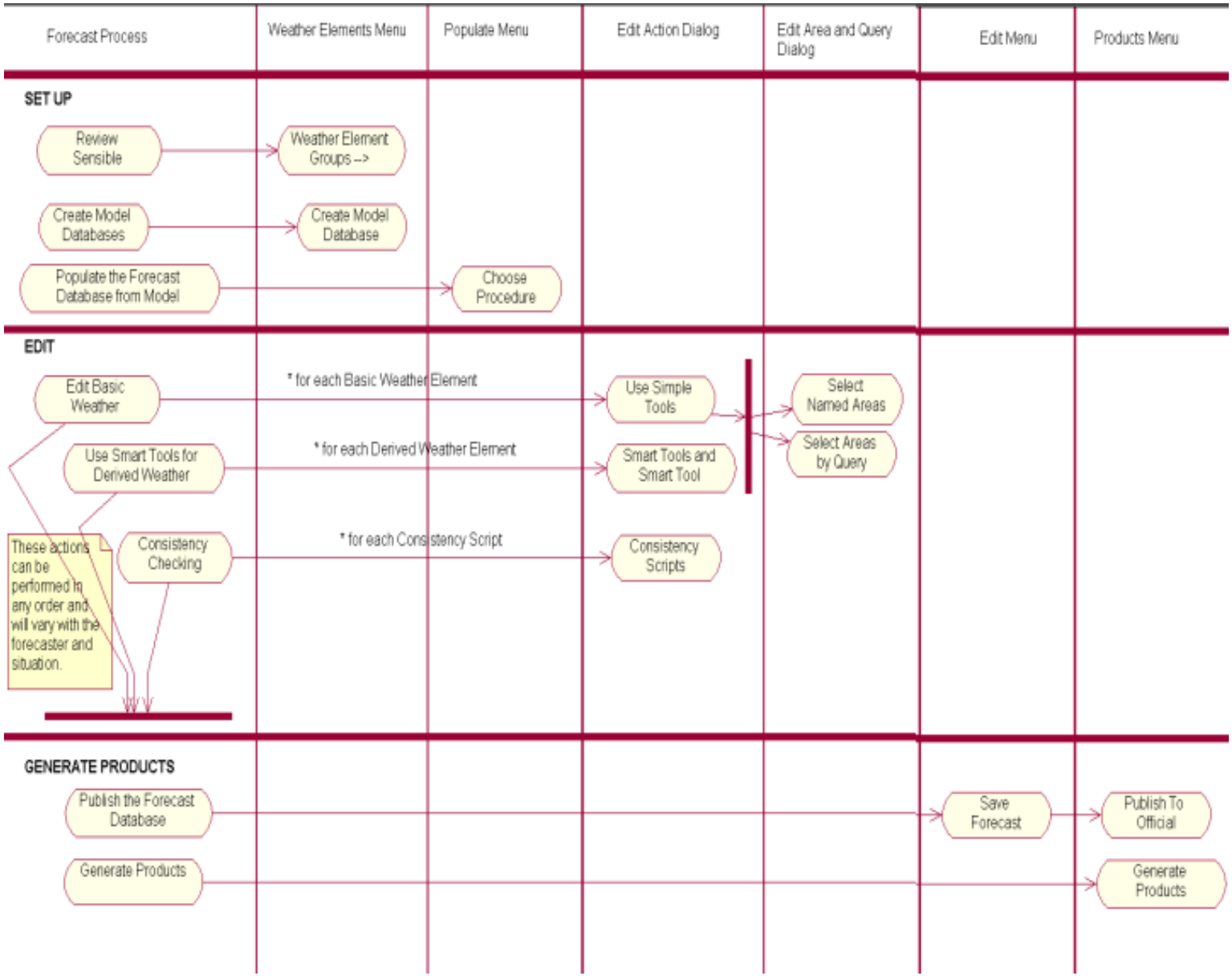

Figure 4. Forecast Process